FLOPPY DISC CONTROL INTERFACE

MODEL FD-ZX

INSTRUCTIONS

AERCO

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CONTENTS

INTRODUCTION

Welcome to the **AERCO FD-ZX** Floppy Disc Interface. This interface is designed to control up to **4** Shugart compatible disc drives. Size can be **3 inch to 8 inch,** single or double sided **(SS/DS)**. 8-inch drives are limited to single density **(SD)**. All others can be single, double, or quad density **(SD/DD/QD)**. In addition to the interface, the minimum disc system requires at least one disc drive and a power supply with **+5v/2A** and **+12v/3A** minimum.

The purchase of the interface includes the short computer cable and a **System Boot Disc** for the specified disc drive. The EPROM is also selected according to the type of drive. Critical specs include: Size of drive, Tracks per side **(35/40/80)**, Number of sides **(SS/DS)**, Track to track access time **(6/12/20/30)** msec. The boot disc has the **16K DOS on page** 1 and the **64K DOS on page** 2. In fact, the 16K DOS is loaded on the inner-most and outer-most page of each side of the disc.

Disc drives are available from **AERCO** or you can use your own. The drives must be modified to jumper **+5v** and **+12v** from the **4-pin power connector** to pins 2 and 34 of the **edge connector** respectively. Care should be taken to cut any traces connected to pins 2 and 34 of the edge connector on the drives. External power need only be run to one of the drives. Be sure to note the orientation of the **beveled corners** on the **4-pin power connector** if you build your own cable The **Drive Select Switch** must be set on each drive. We ship all single drives as **Drive A (DS-0)** unless otherwise specified. With multiple drive systems, the **Terminating Resistor** must be removed from all drives except the one connected to the **end of the 34-conductor Signal Cable.**

CAUTION: CUT ANY TRACES CONNECTED TO PINS 2 OR 34 OF THE DISC DRIVE EDGE CONNECTOR IF YOU MODIFY THE DRIVE. VERIFY PROPER CONSTRUCTION OF THE POWER CABLE IF YOU BUILD IT.

The external power supply is used to power the disc drive(s), FD-ZX interface, and the computer. It requires a **3-conductor** power cable to one of the drives and a cable to the **9v** power jack on the computer. The power converter supplied with the computer is not adequate for the high speed data transfer rate of the disc system **(250 kbits/sec).**

ADDITIONAL CONSIDERATIONS:

1. The FD-ZX EPROM normally occupies the region from 12K (12288) Decimal to 14K (14336) Decimal (3000 to 3800 Hex).

2. It can alternately be located to any 2K region starting at 8/10/14K. The change requires a factory mod which should be specified when ordering the board. If you select an alternate location, all USR calls must be changed accordingly

3. The 2K region occupied by the EPROM must be switched out of systems with 64K

4. There can be noise problems induced onto the computer bus by the 2040 thermal printer. The disc system should be made operational first without the printer. Once the system is debugged, try adding the printer.

5 The disc operating system (DOS) occupies 8K. A minimum of 16K RAM must be installed to load the System Boot Disc.

6. 64K RAM and additional interfaces can usualy be installed between the computer and the short cable. The position of components can be moved for best results.
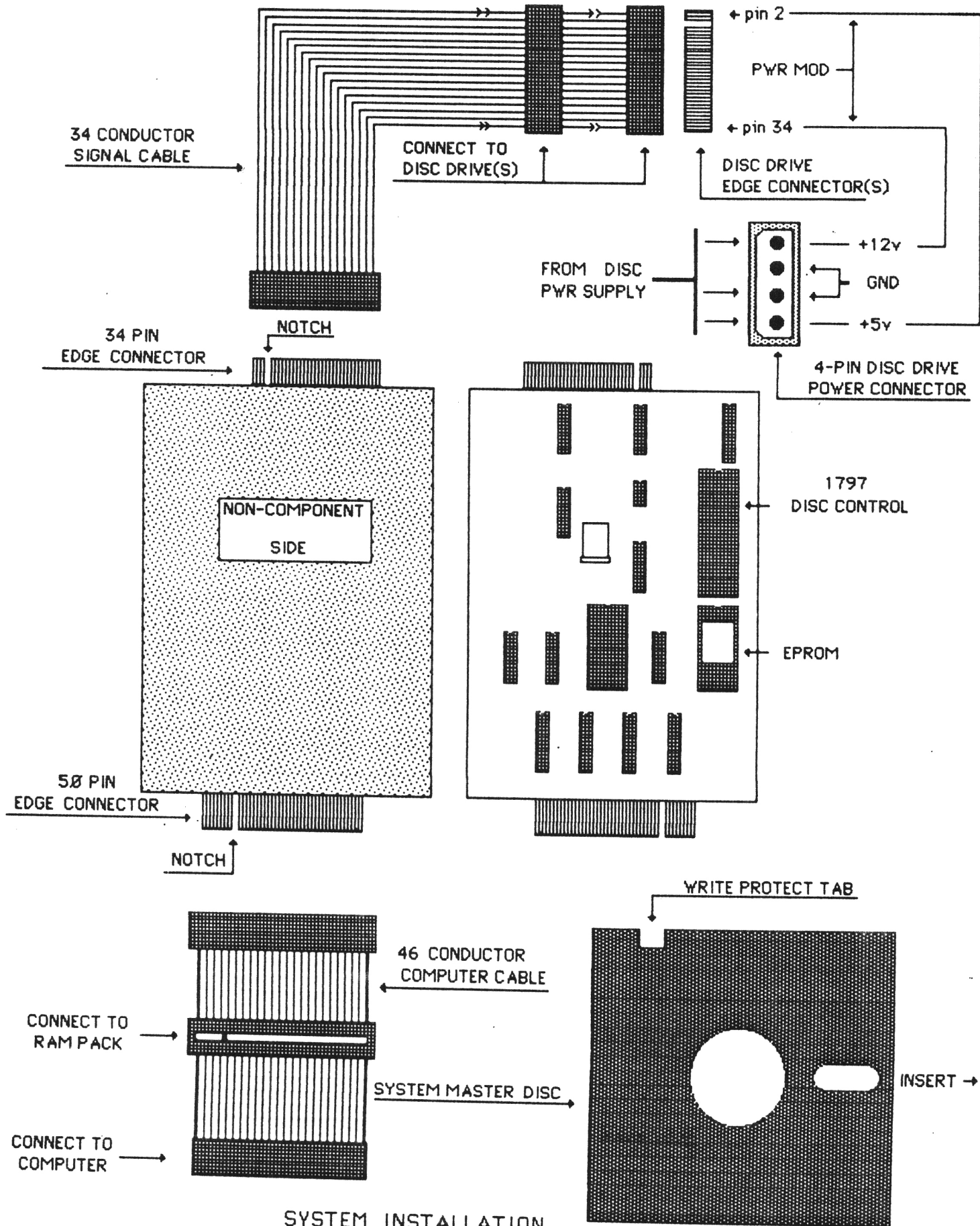
INSTALLATION SET-UP:

NOTE:
Refer to System Installation Drawing

1. Remove power from the computer and the disc power supply.

2. Install the 16K RAM Pack on the center connector of the computer cable.

3 Connect the computer cable to the rear port of the computer. Use the connector that is trimmed down and line up the key with the notch.

4. Insert the large (50-pin) edge connector of the FD-ZX Interface into the other end of the computer cable

5. Install the single connector of the 34-pin signal cable onto the smaller (34-pin) edge connector of the interface.

6. Install the connector on the other end of the signal cable to the disc drive edge connector.

7. Install the remaining signal connector to a second drive.

8. Connect the 3-conductor power cable to the disc drive.

9. Connect the 9v output to the computer.

CAUTION: CHECK ALL CONNECTIONS BEFORE APPLYING POWER.

34 CONDUCTOR
SIGNAL CABLE

CONNECT TO
DISC DRIVE(S)

← pin 2

PWR MOD

← pin 34

DISC DRIVE
EDGE CONNECTOR(S)

FROM DISC
PWR SUPPLY

+12v

GND

+5v

4-PIN DISC DRIVE
POWER CONNECTOR

34 PIN
EDGE CONNECTOR

NOTCH

NON-COMPONENT
SIDE

1797
DISC CONTROL

EPROM

5Ø PIN
EDGE CONNECTOR

NOTCH

WRITE PROTECT TAB

46 CONDUCTOR
COMPUTER CABLE

CONNECT TO
RAM PACK

SYSTEM MASTER DISC

INSERT →

CONNECT TO
COMPUTER

SYSTEM INSTALLATION
DRAWING

GETTING STARTED:

1. Switch OFF your computer and/or disc power supply.
2. Assemble the disc components to your computer per the preceeding instructions.
3. Switch ON computer and/or disc power supply
4. Wait for the K cursor.
5. Insert System Master Disc into drive A. Be sure it is orientated properly. Refer to following NOTES for help.
6 Enter RAND USR 13303 and ENTER.
7. The boot program should load from disc and show the following menu.

WELCOME TO SADOS + 16K 8/83

```
C   COPY DISC (REQUIRES 2 DRIVES)
D   DISC UTILITIES
E   ENTER NAMES IN DIRECTORY
F   FORMAT DISC IN DRIVE A
H   HEX MONITOR
L   LOAD MEMORY FROM DISC
Q   QUIT
S   SAVE MEMORY ON DISC
```

NOTES:
1. The Write Protect Tab normaly faces toward the red busy light on the disc drive. If in doubt, check to see that it is positioned between (2) LEDs when it is inside the drive.
2. All of the disc drive motors turn on whenever a drive is accessed.
3. The red busy lite indicates which drive is being accessed.

EXPLANATION OF COMMANDS:

COPY DISC allows you to duplicate the entire contents of one disc to another. The fresh disc must already be formatted.

DISC UTILITIES allows the following commands:
Clear Directory erases the entire directory listing.
Set Data Mode prepares to load or save data only.
Set Program Mode prepares for program and data. This is the default mode when the system is brought up.
Return to menu does that.
Transfer disc drive selects either A/B/C/or D.

ENTER NAMES IN DIRECTORY allows you to assign names to pages in the directory. Individual names can be erased by entering the page number without a name.

FORMAT DISC IN DRIVE A records track and sector information on fresh discs. Can be used to erase all information on a used disc. It is best to format with 16K RAM. Drive A should always be used to format.

HEX MONITOR allows you to inspect, add, and change bytes in RAM.

LOAD MEMORY FROM DISC loads selected page into BASIC system RAM. Also provides for printed hard copy of the directory.

QUIT exits the DOS to allow entries in BASIC.

SAVE MEMORY ON DISC saves program and/or data in BASIC system RAM to specified page. Note that the entire page (16K or 64K) is reserved for each program.

OPERATING NOTES:

Enter L from the main menu. The following (or similar) directory will be displayed on the screen:

```
 1.  SADOS + 16K  (40 TRACK)
 2.  SADOS + 64K
 3.
 4.
 5.
 6.
 7.
 8.
 9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.
99.  HARD COPY
 0.  RETURN TO MENU
```

L

If you enter 1,10,11,or 20; the main menu will be loaded and displayed. Remmember the 16K DOS is on the 4 "corners" of the disc (only 2 for S/S). Entering 0 will also return to the menu. To get a hard copy of the directory on your printer, enter 99. Enter 2 to load the 64K DOS. If you get a 0/220 report, enter GOTO 1. When you enter L from the 64K DOS, only about one third as many pages appear in the directory. That is because they are 3 times larger. (Note that 16K pages actually equal about 20K).

Before attempting to save onto the disc, you should prepare a back-up. Back-ups should always be made of anything you don't want to lose. The write protect tab should prevent accidental erasure , but why trust fate? Reload page 1 and remove the **Master** disc. Insert a fresh disc (with the write protect cutout exposed) into drive A. Press F and select single or double density. Q will return to the menu. Y for yes will initialize the format routine (N will return to the menu). The disc head will step from the outside in; first on the back side and then on the front. The head will stop at the inside track and the menu will re-appear. The disc is now formatted with track and sector information but not with the DOS. Press S and 1. The DOS is now saved on page 1. You can now save and load on any of the pages. Try it.
Insert the master disc and load page 2. Swap with the back-up disc and enter GOTO 1200. The 64K DOS is now saved on page 2. Quit the DOS and LIST 1200 to find out how.

HOW TO SAVE PROGRAMS OF YOUR OWN OR FROM TAPE

1. Enter or load the program you wish to save. Exit or break (space key) the program if it is running.
2. If the program was loaded from tape, 2 bytes in the BASIC system variables must be restored (16507,8 DEC/ 407B,C HEX). Execute an Initialize command : RAND USR (12865 DD/12860 SD).
3. Enter the command to save the desired page:
           RAND USR (12720 + PAGE).
4. If you want your program to run immediately whenever it is loaded, substitute the following for step 3:
              9998 RAND USR (12720 + PAGE)
               9999 GOTO 1 (or wherever your program starts).
5. Save the program by entering GOTO 9998.
6. The program can now be recalled by loading the same page.

THE DIRECTORY

After you save your programs onto the disc, enter them into the directory. Select E from the main menu and answer the prompts. Listings can be changed by re-entering and erased by entering the page number without a title. When the process is complete, it will return to the main menu. If you want to clear the entire directory, select D from the main menu and then C from the Disc Control Utilities Menu.

USING THE HEX MONITOR

Select H from the main menu to enter the Hex Monitor. All entries are made in Hexidecimal with the decimal value shown in parenthesis. For example: 3000 (12288) is the starting address of the EPROM.

```
     HIMON    1.9     14 AUG 82
Q = QUIT      R (ADR) = RSTRT     ENT = INC 1
S = + 16     (SH) S = + 256   Z = -1    : = -16
G (LIN) = GOTO     H (LIN) = GOSUB




HEX  START  ADR

 " █ "
```

The commands are: (all followed by ENTER)
Q returns to the main menu. Press Q
R (ADR) restarts at the designated address (HEX). Enter RXXXX
ENT increments the address by 1. Press ENTER
S increments the address by 16. Press S
(SH) S increments the address by 256. Press SHIFTED S
Z decrements the address by 1. Press Z
: decriments the address by 16. Press : (colon)
G (LIN) is similar to the BASIC command GOTO. Enter GXXXX
H (LIN) is similar to the BASIC command GOSUB. Enter HXXXX

Enter **3000** for the starting address. Press **ENTER** 5 more times. Press **S** then **(SH) S** and then **R407C**. You should see the following on the screen:

```
3000   (12288)   =   9C   (156)    █
3001   (12289)   =   0E   (14)     :
3002   (12290)   =   03   (3)       ▬
3003   (12291)   =   00   (0)
3004   (12292)   =   00   (0)
3005   (12293)   =   00   (0)
3015   (12309)   =   00   (0)
3115   (12565)   =   0E   (14)     :
407C   (16508)   =   0C   (12)
```

3000 (12288) is the first address of the EPROM. The value is 9C (156) which corressponds with the version of the EPROM. 0 is the sinclair charactor.

Address **407C** stores the track to track access time. **0C (12)** represents the fastest speed **(6 msec)**. Entering **0F (15)** changes the value to the slowest speed **(30 msec)**. If you quit the hex monitor, quit the DOS and enter **PRINT PEEK 16508**, you will get 15. Now **POKE 16508, 12 ENTER** and **GOTO 1** to return to the main menu. Select **H** and enter **407C**. The value is again **0C (12)**. Note that if you access the disc, the value will always be returned to whatever is burned into the EPROM. You need a new EPROM to make a permanent change.

HOW TO COPY DISCS

If you only have one drive, or want to copy a few pages, simply load the desired page from the original disc and save to the desired page on an already formatted disc. Repeat for each page to be copied.

If you have dual drives and want to copy the entire disc, select C from the main menu. Follow the directions and place the original disc in drive B and the **formatted** disc in drive A. The drives will altermately step from track to track. When they stop, the new disc will be a duplicate of the original.

HOW TO TRANSFER DRIVES

Select D from the main menu and T from Disc Control Utilities. Choose A/B/C/ or D and select SD or DD. Q returns to the main menu. The selected drive will read track and sector headers. The information in memory is the same but you now have control of the selected drive.

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Select the Data mode
QUIT the DOS
LET A = 123
GOTO 1
SAVE on page 3
Reset the computer. Turn power OFF and ON and reboot.
Select the Data mode
LOAD page 3
QUIT the DOS
PRINT A

You should get 123 for the value of A. Remember, you **cannot** save BASIC programs in the data mode; **only variables**.

TO SELECT THE PROGRAM MODE

Select **D** from the main menu and **P** from the Disc Control Utilities menu. The main menu will reappear but you are now in the **Program** mode. You cannot distinguish which mode is selected by looking at the menu. If you try to save a program while in the Data mode, it will **not** save. The DOS always boots in the program mode, which can be used for data and/or program.

RAND USR NUMBERS

USR routines are programmed into the EPROM. They can be accessed from the menu or from your programs. The System Master Disc does not have to be loaded to access the USR numbers directly. USR calls can be placed in your programs to perform any of the functions listed on the menu. The first step in using the disc is to **Initialize** (12865 DD/12860 SD). Programs or data can then be loaded or saved with the appropriate call to the selected page. The boot command (13303 DD/ 12345 SD) combines the initialize command with the command to load page 1 (12291). Refer to the **USR Number Listings** for all of the calls. Remember to adjust the numbers if you have the EPROM located at an **alternate** location.

TECH NOTES

As normally shipped, the FD-ZX interface card occupies 2048 bytes of
memory starting at 3000 Hex (12288 Decimal) and mapped as follows.

HEX	DECIMAL	APPLICATION
3000-37F7	12288-14327	On board EPROM for machine language disc routines
37F8 - 37FB	14328-14331	1797 Disc Controller internal registers
37FC - 37FF	14332-14335	LS273 control latch (repeated 4 times)

DEFINITION OF CONTROL LATCH BITS

Bit 0	(Pin 19)	Drive Select A	Active low
Bit 1	(Pin 5)	Drive Select B	Active low
Bit 2	(Pin 16)	Drive Select C	Active low
Bit 3	(Pin 9)	Drive Select D	Active low
Bit 4	(Pin 6)	Data Seperator CD0 1 for 5" DD, 8" SD: 0 for 5" SD	
Bit 5	(Pin 15)	Motor ON and 8"/5" select. 1 for 5", 0 for 8"	
Bit 6	(Pin 12)	Double Density select. 1 for SD, 0 for DD	
Bit 7	(Pin 2)	Control Bit (Spare)	

HEX ADDRESS FOR USEFUL SUBROUTINES

3268	Write contents of A register into command register of Floppy Disc Controller (FDC)
3276	Write contents of A register into track register of (FDC)
327B	Write contents of A register into sector register of (FDC)
3280	Write contents of A register into data register of (FDC)
3285	Write contents of A register into control port
3296	Write Type 1 command in A register to FDC Return: non-zero in A signifies error
32BA	Seek to track specified in B register Return: non-zero in A signifies error
3300	Read one sector HL at RAM, Track in B, Sector in C Return: carry flag for error
3305	Read to end of track Registers / error flag same as above
330A	Write one sector Registers / error flag same as above
330F	Write to end of track Registers / error flag same as above

IF YOU HAVE PROBLEMS

If the computer will not reset or come up at all:
1. Check all of the connections.
2. Refer to Start-Up instructions and Installation Drawing.

If the system will not boot:
1. Switch out the 12K-14K region from 64K RAM.
2. Remove the 2040 Printer.
3. Operate the computer from an external Power Supply with 1-amp min.
4. Keep disc drives away from the flyback transformer in your monitor.
5. Be sure System Disc is inserted properly.

If you need assistance:
Take accurate notes of what happens so we can best help you.

DISC OPERATION THEORY

A disc can most easily be compared to a phonograph record. Data files are recorded in binary form and stored in the concentric grooves (tracks) of the disc. They are accessed by means of a read/write head which is partially analogous to the tone-arm of a record player. However, it is not necessary to move around each track in sequence to reach a particular point; the desired location can be arrived at directly (directly or random-access) by means of the track/sector method of addressing.

For addressing purposes, discs are formatted into tracks and sectors. Tracks are numbered sequentially, starting with the outermost track and working inward. Sectors are wedge-shaped and are numbered around the disc. (Note: sectors are electronic divisions only, not physical; they are not visually discernable.)
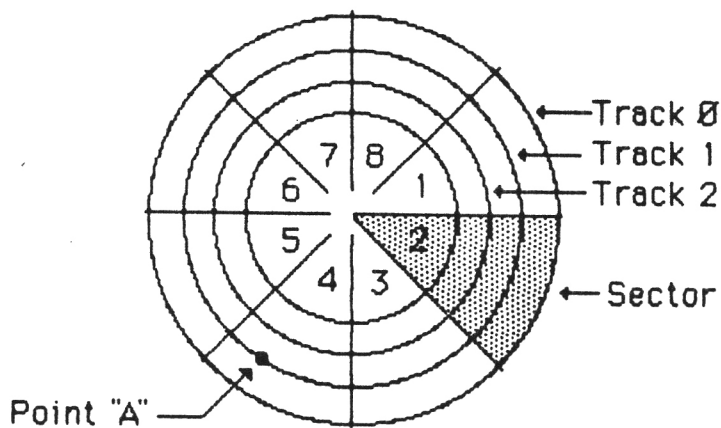
Example: a program starting a Point "A" would be located at track 1, sector 4.

The illustration used is a simplification. A typical floppy disc has 35/40/80 tracks per side with 10 sectors each.

On most floppy discs, tracks and sectors are located by utilizing a series of magnetic markers or headers which are spaced around the tracks at the beginning of each sector. The disc is kept constantly spinning at high speed (300 RPM); as the read/write head passes over each header, magnetically-encoded information including track and sector number, which side of the disc, and size of the track sector (256 SD/512 DD) is relayed to the disc drive circuitry. Thus, to access a particular address, the drive moves the head in or out to the correct track and then locates the desired sector, all by reading the disc headers.

An additional means of sector orientation is the index hole in the disc, located near the center, marking the beginning of sector 1. As the disc spins, the hole periodically aligns with another hole in the disc envelope, allowing a ray of light to pass through to a sensor in the drive circuitry. Although this does allow calibration from sector 1, its main purpose is to provide a check on the operation of the disc itself. The disc circuitry will be alerted to any irregularity of the disc spin (slowing, stopping, etc.) by changes in the timing of the sensor ray.

USR NUMBER LISTING

(Note: Adjust USR numbers if EPROM is located at alternate address, 2048 for each 2K)

LOAD COMMANDS (12290+PAGE)

USR	12291	Read disc page	1	into BASIC system RAM	
USR	12292	Read disc page	2	into BASIC system RAM	
USR	12293	Read disc page	3	into BASIC system RAM	
USR	12294	Read disc page	4	into BASIC system RAM	
USR	12295	Read disc page	5	into BASIC system RAM	
USR	12296	Read disc page	6	into BASIC system RAM	
USR	12297	Read disc page	7	into BASIC system RAM	
USR	12298	Read disc page	8	into BASIC system RAM	– MAXIMUM DD/SS/35T
USR	12299	Read disc page	9	into BASIC system RAM	
USR	12300	Reas disc page	10	into BASIC system RAM	– MAXIMUM DD/SS/40T
USR	12301	Read disc page	11	into BASIC system RAM	
USR	12302	Read disc page	12	into BASIC system RAM	
USR	12303	Read disc page	13	into BASIC system RAM	
USR	12304	Read disc page	14	into BASIC system RAM	
USR	12305	Read disc page	15	into BASIC system RAM	
USR	12306	Read disc page	16	into BASIC system RAM	– MAXIMUM DD/DS/35T
USR	12307	Read disc page	17	into BASIC system RAM	
USR	12308	Read disc page	18	into BASIC system RAM	
USR	12309	Read disc page	19	into BASIC system RAM	
USR	12310	Read disc page	20	into BASIC system RAM	– MAXIMUM DD/DS/40T

SAVE COMMANDS (12720+PAGE)

USR	12721	Write BASIC system RAM onto disc page	1	
USR	12722	Write BASIC system RAM onto disc page	2	
USR	12723	Write BASIC system RAM onto disc page	3	
USR	12724	Write BASIC system RAM onto disc page	4	
USR	12725	Write BASIC system RAM onto disc page	5	
USR	12726	Write BASIC system RAM onto disc page	6	
USR	12727	Write BASIC system RAM onto disc page	7	
USR	12728	Write BASIC system RAM onto disc page	8	– MAXIMUM DD/SS/35T
USR	12729	Write BASIC system RAM onto disc page	9	
USR	12730	Write BASIC system RAM onto disc page	10	– MAXIMUM DD/SS/40T
USR	12731	Write BASIC system RAM onto disc page	11	
USR	12732	Write BASIC system RAM onto disc page	12	
USR	12733	Write BASIC system RAM onto disc page	13	
USR	12734	Write BASIC system RAM onto disc page	14	
USR	12735	Write BASIC system RAM onto disc page	15	
USR	12736	Write BASIC system RAM onto disc page	16	– MAXIMUM DD/DS/35T
USR	12737	Write BASIC system RAM onto disc page	17	
USR	12738	Write BASIC system RAM onto disc page	18	
USR	12739	Write BASIC system RAM onto disc page	19	
USR	12740	Write BASIC system RAM onto disc page	20	– MAXIMUM DD/DS/40T

(Note: Adjust USR numbers if EPROM is located at alternate address, 2048 for each 2K)

|		
USR	12345	Boot system from SINGLE density disc in drive A
USR	13303	Boot system from DOUBLE density disc in drive A
USR	12800	Turn drive motor ON
USR	12852	Turn drive motor OFF
USR	12860	Initialize system for SINGLE density operation, select drive A
USR	12865	Initialize system for DOUBLE density operation, select drive A
USR	13040	Set SINGLE density operation on selected drive
USR	13290	Set DOUBLE density operation on selected drive
USR	13265	Select drive A
USR	13266	Select drive B
USR	13267	Select drive C
USR	13268	Select drive D
USR	13312	Format disc in drive A. (ERASES ALL FILES) NOTE: Density mode must be set first
USR	13760	Copy from drive B to drive A
USR	13891	Set Program mode
USR	13898	Set Data mode

64K Program Utility

USR	14001	Write system RAM onto disc page 1
USR	14002	Write system RAM onto disc page 2
USR	14003	Write system RAM onto disc page 3
USR	14004	Write system RAM onto disc page 4
USR	14005	Write system RAM onto disc page 5
USR	14006	Write system RAM onto disc page 6
USR	12291	Read disc page 1 into system RAM
USR	12294	Read disc page 2 into system RAM
USR	12297	Read disc page 3 into system RAM
USR	12299	Read disc page 4 into system RAM (35T drive)
USR	12301	Read disc page 4 into system RAM (40T drive)
USR	12302	Read disc page 5 into system RAM (35T drive)
USR	12304	Read disc page 5 into system RAM (40T drive)
USR	12305	Read disc page 6 into system RAM (35T drive)
USR	12307	Read disc page 6 into system RAM (40T drive)

NOTE: 35T drive has 16 pages in 16K DOS/ 40T drive has 20 pages in 16K DOS
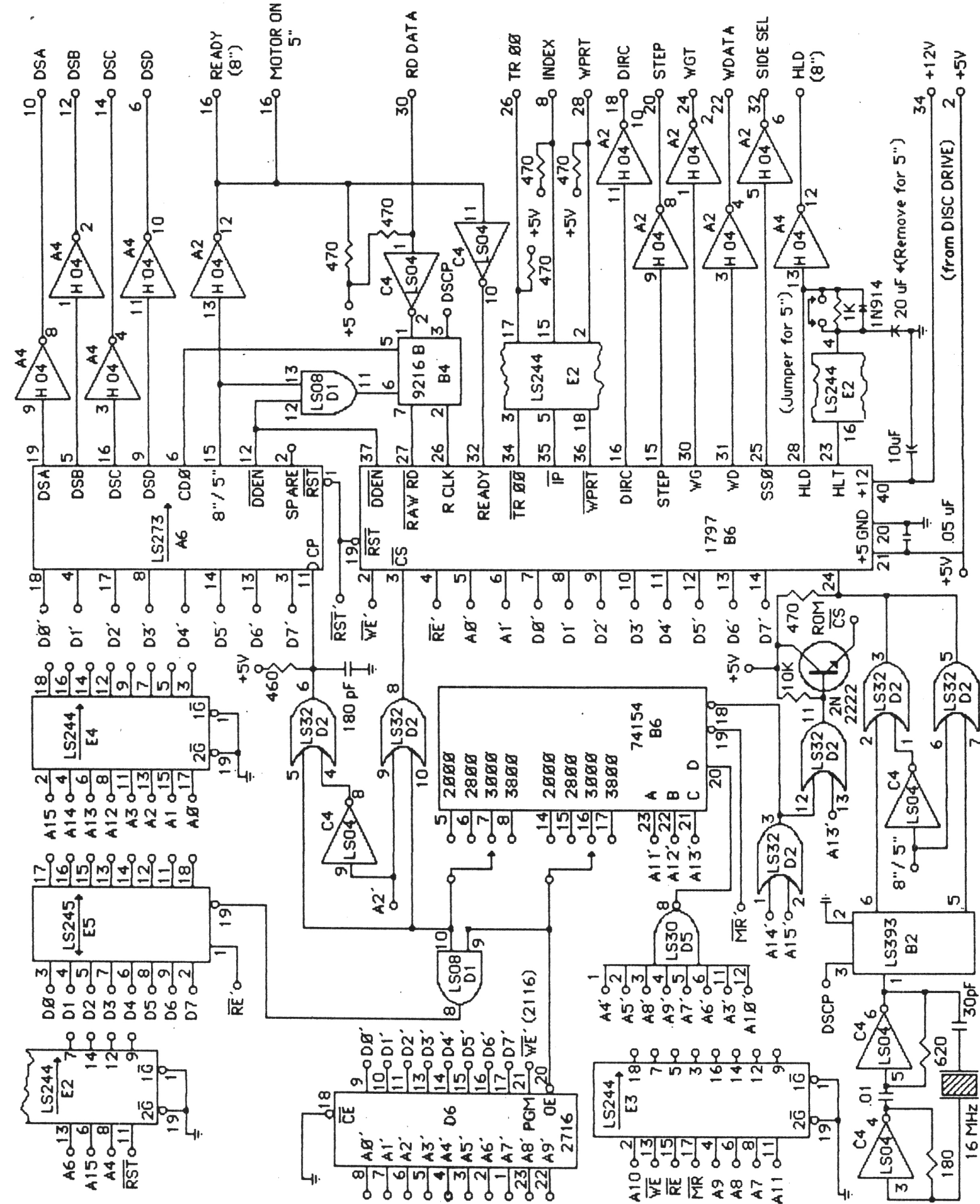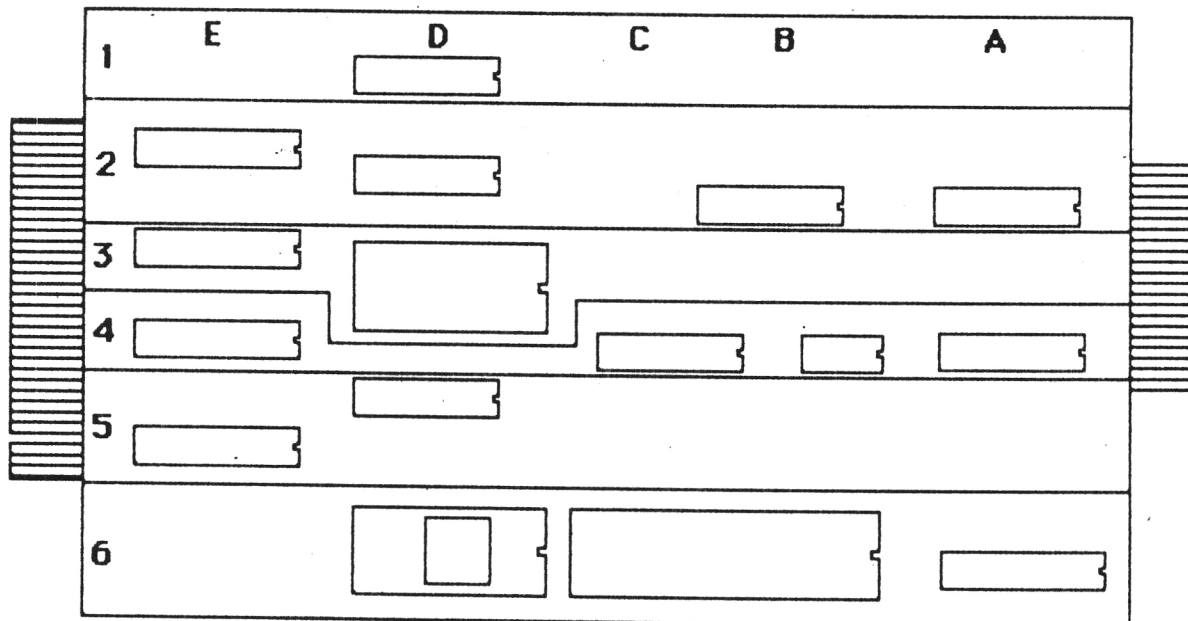
DEVICE	REF DES	+5	GND	+12	NOTES
74H04	A2,4	14	7		HEX INVERTER (O.C.)
74LS04	C4	14	7		HEX INVERTER
74LS08	D1	14	7		(4) 2-input AND
74LS30	D5	14	7		8-input NAND
74LS32	D2	14	7		(4) 2-input OR
74LS244	E2,3,4	20	10		BUFFER
74LS245	E5	20	10		BUFFER
74LS273	A6	20	10		8-bit LATCH
74LS393	B2	14	7		COUNTER
74154	D3	24	12		DECODER
2716	D6	24	12		EPROM
9216B	B4	8	4		DATA SEPARATOR
FD1797-02	B6	21	20	40	DISC CONTROLLER

ASSEMBLY DRAWING

FD-ZX FLOPPY DISC INTERFACE REV.4